

REMARKS

Applicants request favorable reconsideration and allowance of the subject application in view of the preceding amendments and the following remarks.

To place the subject application in better form, the specification has been amended to correct minor informalities. Also, a new abstract is presented in accordance with preferred practice. No new matter has been added by these changes.

Claims 1-15 are presented for consideration. Claims 1 and 7 are independent. Claims 1, 7 and 13 have been amended to clarify features of the invention. Support for these changes can be found in the application, as filed. Therefore, no new matter has been added.

Applicants request favorable reconsideration and withdrawal of the objection and rejections set forth in the above-noted Office Action.

The Examiner objected to the drawings on formal grounds. Specifically, the Examiner asserted that Figure 1 should be designated by a legend such as -- PRIOR ART -- because, the Examiner asserts, only that which is old is illustrated. This contention is respectfully traversed. Applicants submit that Figure 1 must be read in light of Figure 7. Specifically, Figure 7 is a block diagram showing the construction of the control system of the electron beam exposure system shown in Figure 1, while Figure 1 is a schematic diagram showing an electron beam exposure system in accordance with a preferred embodiment of the present invention. Accordingly, in this application, Applicants do not intend that Figure 1 represents the prior art. Accordingly, Applicants request that the Examiner reconsider and withdraw this objection to the drawings.

Turning now to the art rejections, claims 1-3, 6 and 15 were rejected under 35 U.S.C. § 103 as being anticipated by U.S. Patent No. 5,955,738 to Manabe et al. Claims 7, 9, 10, 12 and 13 were rejected under 35 U.S.C. § 103 as being unpatentable over the Manabe et al. patent in view of U.S. Patent No. 5,313,068 to Meiri et al. Applicants submit that the cited art, whether taken individually or in combination, does not teach many features of the present invention, as recited in independent claims 1 and 7. Therefore, these rejections are respectfully traversed.

In one aspect of the invention, independent claim 1 recites a charged particle beam exposure system which draws a pattern on an object to be exposed by a plurality of charged particle beams emitted from a plurality of elements electron optical systems. One of the features of the present invention recited in that claim is that a storage device stores calibration data for correcting variations in an irradiation dose among the plurality of the charged particle beams emitted from the plurality of element electron optical systems. Applicants submit that the Manabe et al. patent does not teach or suggest such features of the present invention, as recited in independent claim 1.

The Manabe et al. patent relates to an exposure data preparing apparatus that includes a field placement editor for placing exposure patterns that correspond to design data. Placement is done for each sub-field obtained by dividing a field on an LSI to be designed, and each sub-field has a size that can be covered by deflection of a beam from an exposure apparatus. A map preparing editor prepares a plurality of maps that can be covered by a single shot of the charged particle beam, by dividing the sub-field in which the exposure pattern is placed. A CPU

determines a beam dosage of the charged particle beam derived from a density of the exposure pattern in the map.

The charged particle beam exposure apparatus in the Manabe et al. patent, however, does not draw a pattern by a plurality of charged particle beams emitted from a plurality of element electron optical systems, in the manner of the present invention recited in independent claim 1. This can be seen in more detail in the Manabe et al. patent in Figure 31, which is discussed at column 23, lines 8-41. Naturally, therefore, the Manabe et al. does not disclose a storage device of the present invention recited in independent claim 1, which stores calibration data for correcting variations in an irradiation dose among the plurality of charged particle beams emitted from the plurality of element electron optical systems.

The Meiri et al. patent does not cure the deficiencies noted above with respect to the Manabe et al. patent.

The Meiri et al. patent also shows a method of partitioning design shapes, in an e-beam lithography system, into sub-shapes such that a constant dose may be applied to an e-beam sensitive resist within each sub-shape. In the Meiri et al. patent, in each sub-shape, the constant dose corresponds to an approximation to an indicator function indicating the degree of proximity effect such as the effective exposure of the resist from back scattered or the required dose. The approximation error is equal to a predetermined value for each sub-shape and can depend upon the position of the sub-shape within the shape and the influence of errors in the applied dose at that position with respect to the position of the edge of the shape. That patent, however, as with the Manabe et al. patent, does not teach or suggest a charged particle beam exposure system

which draws a pattern by a plurality of charged particle beams emitted from a plurality of element electron optical systems. Therefore, that patent likewise does not teach or suggest the storage device of the present invention recited in independent claim 1, which stores calibration data for correcting variations in the irradiation dose among the plurality of the charged particle beams emitted from the plurality of element electron optical systems.

In another aspect of the invention, independent claim 7 recites a method for correcting exposure data for drawing a pattern on an object to be exposed by a plurality of charged particle beams emitted from a plurality of element electron optical systems. The method includes, among other features, determining optimum proximity effect correction data for controlling standard dose data in accordance with a judgment as to whether a selected piece of proximity effect correction data is the optimum data for controlling the standard dose, measuring, by a sensor, the irradiation dose of the charged particle beams from each element electron optical system, the irradiation dose having been subjected to a correction by proximity effect correction data and determining the calibration data of each of element electron optical systems, based on the irradiation dose measured in the measuring step.

Applicant submits that the cited art likewise does not teach or suggest such features of the present invention, as recited in independent claim 7.

As discussed above, the Manabe et al. patent discusses an exposure data preparing apparatus that includes a field placement editor for placing exposure patterns that correspond to design data. Applicants submit, however, that that patent does not teach or suggest anything regarding determining optimum proximity effect correction data for controlling standard dose

data or measuring an irradiation dose of charged particle beams from each element electron optical system, in the manner of the present invention recited in independent claim 7.

Applicants further submit that the Meiri et al. patent does not cure the deficiencies noted above with respect to the Manabe et al. patent.

Applicants submit that the Meiri et al. patent only teaches partitioning a shape into sub-shapes of various sizes. Each sub-shape receives a constant dose based on a one-dimensional representative indicator function which may indicative of the degree of proximity effect. As discussed at column 4, lines 58-62 of the Meiri et al. patent, the proximity correction is performed by a module solely from design data and already determined calibration data that characterizes the particular e-beam lithography system. Accordingly, the Meiri et al. patent fails in any manner to teach or suggest any measurement of irradiation dose by a sensor, which radiation dose has already been subjected to correction by proximity effect correction data to determine calibration of each of the element electron optical systems, in the manner of the present invention recited in independent claim 7. Therefore, the Meiri et al. patent again fails to cure the deficiencies noted above with respect to the Manabe et al. patent.

For the reasons advanced above, Applicants submit that the Meiri et al. patent adds nothing to the teachings of the Manabe et al. patent that would render obvious Applicants' present invention as recited in independent claims 1 and 7.


For the foregoing reasons, Applicants submit that the present invention, as recited in independent claims 1 and 7, is patentably defined over the cited art, whether that art is taken individually or in combination.

The dependent claims also should be deemed allowable, in their own right, for defining other patentable features of the present invention in addition to those recited in their respective independent claims. Further individual consideration of these dependent claims is requested.

Applicants further submit that the instant application is in condition for allowance. Favorable reconsideration, withdrawal of the objection and rejections set forth in the above-noted Office Action and an early Notice of Allowance are requested.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should be directed to our address listed below.

Respectfully submitted,



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